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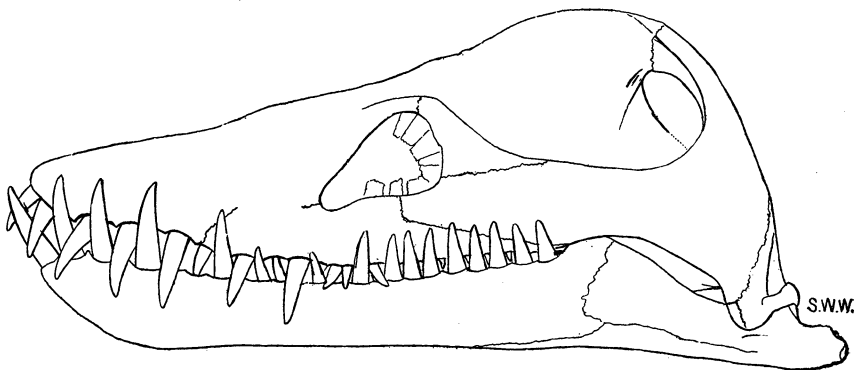
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## A NEW PLESIOSAUR FROM THE NIOBRARA CRETACEOUS OF KANSAS.

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During the past summer, Judge E. P. West, of the University of Kansas, obtained from the chalk of western Kansas a specimen of a plesiosaur, which is of especial interest, both by reason of the comparative rarity of these animals and of the nature and preservation of the remains obtained. The specimen comprises the skull and twenty-eight cervical vertebræ, all attached and with their relative positions but little disturbed. They lie upon the right side, with the usual opisthotonic curve to the neck, and are all laterally compressed. The right side of the skull is not at all disturbed, save from the effects of compression and of chemical action upon the teeth. The upper side, however, though the teeth are in perfect preservation, and the relative positions of the mandible and maxilla are unchanged, has been crowded up about three inches, nearly obliterating the orbit.

In the absence of other material for comparison, and some of the necessary literature, I shall not attempt to enter into a full description of the specimen, but shall reserve such for another time, when my opportunities will be greater. Most of the sutures will, I believe, be traced out, but at present I have not sufficiently distinguished some from the cracks due to compression. In the figure herewith given I have indicated such only as are beyond doubt.

Skull of *Cimoliosaurus* (*Elasmosaurus?*) *snowii* Will., about  $\frac{1}{2}$ .

## SKULL.

*Parietals*.—The parietals form a high, steep, roof-like covering, ascending into a sharp, thin sagittal crest, extending through nearly their whole length—from near the attachment of the squamosals posteriorly as far forward as the posterior part of the orbit. This crest, throughout most of its extent, forms a plate of bone with nearly parallel sides for about two inches vertically, its thickness on the margin varying from two to four millimeters, and its entire length about 130 millimeters. Posteriorly they expand into a thickened triangular process, directed upward and backward over the supraoccipital—for union with the squamosals. Extending the whole length of the crest is a well-marked suture, and it is possible that at or near the anterior extremity there may have been a parietal foramen; but, if so, the opening has been closed by the compression.

*Frontals*.—The frontals are small bones; neither the anterior or posterior sutures have been traced, but, allowing for compression, the distance between the upper borders of the orbits could not have exceeded three inches. The two bones meet in a roughened suture, which, for more than an inch, seems to have been imperfectly closed in life.

*Post-fronto-orbitals.*—These elements appear as a slender bar running downward and backward, and, in life, evidently also obliquely outward. The union with the frontal above and the jugal below is shown in the figure. The bone is triangular in shape, the jugal suture extending back horizontally about 70 mm. I do not find a differentiation of the two elements, though such may have been the case.

*Temporal arch.*—The jugal enters into the posterior inferior portion of the orbit, articulating more than two inches with the jugal above, and by a long, oblique suture, more than four inches in length, with the maxilla below. Just what its relations posteriorly are I cannot now say. The bone called “squamosal” I at first confined to the upper process, but further cleaning makes the supposed suture a doubtful one.\* It is possible that what seems a small ossification at the lower end of the quadrate, in front, may be the quadrato-jugal. If this be so, the bar must consist wholly of the “squamosal” and jugal. The suture distinguishing this “jugal-squamosal” from the quadrate is very distinct, at least in the lower part. It extends from near the lower end, in front, upward and backward, to the posterior surface. Sollas† describes a transverse suture at the anterior part of the arch in *Plesiosaurus Conybeari*, whereby “the jugal, post-orbital and squamosal clearly meet in a T-shaped suture.” There is no evidence whatever of any such suture in the present specimen. Did it exist, the squamosal would necessarily articulate with the maxilla, as well as the other bones. Prof. Huxley, as quoted by Sollas (l. cit.), says that, “contrary to what is usually stated, the post-frontal appears to articulate with a bone, the homologue of the squamosal of the crocodile.” Possibly he is correct, but I believe not. Certainly there is no such arrangement as he figures and positively states in his *Comparative Anatomy*; upon what evidence I do not know, as more recent authors (Baur, Lydekker) agree in rejecting his views as improbable. There is but a single temporal arch, and it probably, as Baur suggests, represents both the upper and lower arches of crocodilia, Dinosauria, etc.

*Pterygoids.*—The pterygoids unite posteriorly with the lower end of the quadrate, and send off a process, evidently the transverse, back of the middle of the mandibles.

*Premaxillary.*—The premaxillaries are large, with pit-like depressions on their outer surface. The median suture is evident; but that separating them from the maxillaries I have traced only a short distance upward and backward.

*Sclerotic plates.*—Lying within the orbit are thirteen small, thin, bony plates, the largest about 20 mm. in its greatest diameter, with somewhat crenulated edges. The larger part are lying in position; others are misplaced.

*Mandible.*—The lower jaw, from the tip of the symphysis to the hind extremity, measures just twenty inches, of which the teeth occupy thirteen. Its least width, near the middle, is one and three-fourths inches; its greatest width, just back of the teeth, is nearly three inches. The length of the symphysis is two and three-fourths inches. The two dentaries are firmly coössified, traces of the suture being seen at the posterior part only. The ossification is so complete that compression has not affected the symphyseal portion, but, instead, has broken the left ramus just back of the symphysis. The sutures separating the angular, surangular and dentary are, as is seen, very similar in position to those of the crocodile.

*Teeth.*—There are sockets in the lower jaws for nineteen or twenty teeth. There is possibly one more on the right than on the left side. Those in the upper jaw seem to be the same in number, though the small posterior ones are so covered by the lower teeth that the number cannot be determined positively. The largest teeth of the upper jaw are the five implanted in the premaxillary; back of these

\* This process is said to be distinct in some specimens of *Plesiosaurs*, and is spoken of as the “supra squamosal, or supra temporal.” It is probably the true squamosal, if distinct. Vide Baur, *Jour. of Morph.*, III, 473.

† Quart. Journ. Geol. Soc., 1881, p. 444.

there is but one large tooth, situated just in front of the orbit. The largest teeth of the lower jaw are the ones corresponding to those of the premaxillary; the posterior teeth, however, are much larger than the corresponding ones in the upper jaw. The anterior teeth, especially, are elongate, conical and lightly recurved. All are sharply pointed, with the crown, to within a half or three-fourths inch of the socket, finely striated. The largest is that of the premaxillary, just in front of the maxillary suture, measuring 53 mm. in length by 13 mm. in width at the base. The first tooth in the lower jaw is fully as long, but a little more slender.

The entire length of the skull is about nineteen inches; its greatest height, about nine inches. The width at the extremity of the quadrates, as indicated by the plane of the mandibular symphysis, could not have been great. It is very evident that



Third cervical vertebra. *C. Snowii* Willist. x $\frac{1}{2}$ .

the skull was a long and narrow one, quite similar to that of *Plesiosaurus Conybeari* Sollas, and very different from the depressed ones, with flat parietals, indicated by other remains.

The extremity of a small bone was found lying upon the inner side of the lower mandible; it is evidently a part of a hyoid bone.

#### CERVICAL VERTEBRÆ.

Twenty-eight vertebræ, in a continuous series, were obtained by Mr. West, the last five or six, owing to exposure, in less perfect condition; the others with their various processes complete, or nearly so. Traces of the sutures uniting the neural arches with the centra can be distinguished in the third and fourth vertebræ, but in all the others they are entirely obliterated. The atlas and axis have not been separated from the skull, and the characters of the former cannot be made out. There are no zygoxenes. The third vertebra, as figured, differs from the following ones in the greater obli-

quity and slightly greater length of the spine, in the more oblique anterior face of the centrum, in the presence of a conspicuous carina below in front, and in the simple, pointed shape of the pleurapophyses. The measurements of this vertebra are as follows:

THIRD CERVICAL VERTEBRA.		
Length of centrum, below.....	23 millim.	
Length of centrum, above.....	20 "	
Height of centrum.....	25 "	
Width of centrum.....	22 "	
Height of spine above floor of neural canal.....	55 "	

The fourth vertebra has the neural spine less oblique and broader, the carina, in the middle of the concavity of the under surface, not visible from the side, and the pleurapophysis broad, and of equal width.

FOURTH CERVICAL VERTEBRA.		
Length of centrum.....	30 millim.	
Height of centrum.....	27 "	
Height of spine above floor of neural canal.....	46 "	
Width of spine.....	24 "	
Length of pleurapophyses.....	43 "	
Width of pleurapophyses.....	24 "	

The sixth vertebra has the spine nearly perpendicular, and the pleurapophyses broad, with more marked terminal anterior and posterior prolongations.

SIXTH CERVICAL VERTEBRA.	
Length of centrum.....	48 millim.
Height of centrum.....	42 "
Height of spine above floor of canal.....	47 "
Width of spine.....	36 "

NINTH CERVICAL VERTEBRA.	
Length of centrum.....	53 millim.
Height of centrum.....	42 "
Height of spine above floor of canal.....	47 "
Width of spine.....	40 "
Length of pleurapophyses.....	40 "
Least width of pleurapophyses.....	25 "
Greatest width of pleurapophyses, distally.....	49 "

FOURTEENTH CERVICAL VERTEBRA.	
Length of centrum.....	65 millim.
Height of centrum.....	50 "
Height of spine.....	50 "
Width of spine.....	42 "
Length of pleurapophyses.....	48 "
Least width of pleurapophyses.....	32 "
Greatest width of pleurapophyses, distally.....	56 "

TWENTIETH CERVICAL VERTEBRA.	
Length of centrum.....	78 millim.
Height of centrum.....	60 "
Height of spine.....	62 "
Width of spine.....	65 "
Greatest width of pleurapophyses, distally.....	65 "

TWENTY-SEVENTH CERVICAL VERTEBRA.	
Length of centrum.....	90 millim.
Height of centrum.....	68 "

TWENTY-NINTH ? THIRTIETH ? CERVICAL VERTEBRA.	
Height of centrum.....	77 millim.
Width of centrum.....	74 "
Depth of cup.....	12 "

#### SYSTEMATIC POSITION.

In the absence of any definite knowledge of the skull-structure of other American plesiosaurs, and not very much knowledge, and that in a measure contradictory, of the European forms, it is a matter of some difficulty to correctly refer the present species to any definite genus. In *Science*, vol. XVI, p. 262, I provisionally referred it to *Cimoliosaurus* Leidy, under the name *C. Snowii*, in honor of Chancellor F. H. Snow. But the genus *Cimoliosaurus*, as defined by Lydekker, will include absurdly composite forms. Among the material in the museum of the University of Kansas there are a dozen or more specimens from the Kansas Cretaceous certainly referable to at least three distinct genera, all of which might be included in *Cimoliosaurus* of Lydekker and Zittel.

It cannot be denied that there is a striking resemblance between our present skull and that described by Sollas (loc. cit.) as *Plesiosaurus Conybeari* Sollas, and I am strongly tempted to believe that the two forms are congeneric. On the other hand, such a definition of *Plesiosaurus* as the following, from Zittel's *Hand-Buch*, vol. III, pp. 489 and 490, will prohibit the admission of our species: " . . . Augenhöhlen rundlich, ungefähr in die Mitte der Schädellänge, ohne verknöcherten Skleroticing; Schläfenlöcher gross, vierseitig. . . . Scheitelbeine verschmolzen, schmal und kurz; Jochbein kräftig, gebogen; Quadratjochbein nach hinten vorspringend, die seitliche Hinterecke des Schädels bildend. . . . Zahnbeine vorn zu einer breiten

Symphyse verschmolzen. . . . Sämmtliche Wirbelkörper sind ziemlich kurz, vorn und hinten fast flach oder nur ganz schwach ausgehöhlt; die Bogen durch Nähte mit dem Centrum verbunden, so das sie sich leicht ablösen." Furthermore, both Seeley and Lydekker would restrict the genus *Plesiosaurus* to the Lias.

From *Cimoliosaurus*, in Lydekker's wide sense, there are important differences. The anterior teeth are much larger than the posterior ones, and there are no xygophenes on the cervical vertebræ. But, while the genus is evidently different from *Cimoliosaurus* as there defined, it is not so certain that it is distinct from some of the forms included under it. Lydekker, and, following him, Zittel, divide *Cimoliosaurus* into two groups, the cœlospondyline, "probably equivalent to *Polycotylus* Cope," and the "Typical Group," including *Elasmosaurus* Cope, *Mauisaurus* Hector, and *Muraenosaurus* Seely. From this group, Lydekker's definition will sharply exclude our form; but, nevertheless, I do not feel so sure that it is generically different from *Elasmosaurus*. Cope had only a fragment of the skull, and the cervical vertebræ that he describes and figures had the processes so broken away that there is but little left for comparison, save the relative lengths. From this character alone it appears that the vertebræ of our species are less slender, the greatest disproportion between length and height being as nine to seven, while a median cervical of *Elasmosaurus platyrus* Cope, figured by the author, has a relation of eight to five. There are, also, other differences in the sculpturing, which are, at least, of specific value. If the type of *Elasmosaurus* has zygosphenal vertebræ, there can be no question of the generic distinction; but I cannot find any statement of the author to that effect. So the question must yet remain of the generic identity of the animal until more material has been obtained. Of the specific distinction, however, there can be scarcely a question, and, hence, the name here given.

Great credit is due to Mr. West for his recognition of the value of this specimen, and his corresponding care in its collection. I desire, also, to express my thanks to my friend, Dr. George Baur, of Clark University, for the communication of literature, and various suggestions.

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